

Table 2: **p24**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(1–11)	p24(1–11 SF2)	PIVQNLQGQMV	HIV-1 infection	human(DR1)	[Harcourt1998]
	<ul style="list-style-type: none"> • 43 asymptomatic HIV+ individuals were screened for proliferative responses to HIV – 12 showed a response, and dominant epitopes were mapped for two individuals, one in p24 and one in p17 • Out of five truncated versions of peptide PIVQNLQGQMVHQAI SPRTL, only p24-1/11 elicited a proliferative response • Nine naturally occurring variants of this epitope were found within the individual who made this response – all bound to HLA-DR1, but three did not stimulate the CD4+ T-cell line that recognized the index peptide, suggestive of immune escape 				
p24(1–15)	p24(133–147 IIIB B10)	PIVQNIQGQMVHQAI	HIV-1 infection	human()	[Wahren1989, Wahren1989a]
	<ul style="list-style-type: none"> • Peptides were identified that commonly evoke T-cell responses – 62% of 90 HIV+ people had a T-cell response to this peptide 				
p24(1–22)	p24(133–154 SF2)	PIVQNIQGQMVHQAI SPRTLNA	HIV-1 infection	human()	[Rosenberg1997]
	<ul style="list-style-type: none"> • While anti-HIV CD4 Th responses are characteristically undetectable in chronic infections, strong p24-specific proliferative responses were inversely correlated with low viral load in 10 chronically infected people • The dominant proliferative response in one of two long term survivors was to this peptide 				
p24(7–21)	Gag(171–185)	QGQMVHQAI SPRTL N	HIV-1 infection	human(DR supermotif)	[Wilson2001]
	<ul style="list-style-type: none"> • Epitope name: Gag 171. Eleven peptides were identified that had the HLA-DR supermotif, all were found to bind to MHC class II DR molecules and all elicited proliferative responses from multiple HIV-infected donors • This epitope binds to nine HLA-DR alleles: DRB1*0101, DRB1*1501, DRB1*0401, DRB1*0405, DRB1*1302, DRB1*0701, DRB1*0901, DRB5*0101 and DRB4*0101 with an IC50 threshold below 1,000 nM • This epitope sequence is conserved in 52% of clade B isolates • 7/22 HIV infected individuals responded to this epitope (13/22 responded to some of the DR supermotif epitopes, the 9 non-responder peptides tended to also not have recall responses to rec HIV-1 whole proteins) 				
p24(11–26)	p24(143–157)	VHQAI SPRTL NAWVKC	<i>in vitro</i> stimulation	human()	[Bedford1997a]
	<ul style="list-style-type: none"> • Epitope elicits a primary proliferative response in PBMC from uninfected donors • Matches 3/3 anchor residues for HLA DR: VHQAI SPRT 				
p24(11–30)	p24(143–162 HXB2)	VHQAI SPRTL NAWVK- VVEEK	Vaccine	murine(H-2 ^d , H-2 ^b)	[Mata1999]

Vaccine: Vector/type: *Listeria monocytogenes* Strain: HXB2 HIV component: Gag

- BALB/c and C57BL/6 mice were immunized with rec *Listeria monocytogenes* (Lm-Gag) expressing HIV-1 HXB2 Gag
- *L. monocytogenes* is a gram-positive bacteria that enters the macrophage on phagocytosis and lives in the cytoplasm – secreted *L. monocytogenes* antigens are processed and presented by both class I and class II pathways

HIV Helper-T Cell Epitopes

- The class II T-helper response was probed using 20 mer peptides that overlapped by 10, and the peptides VHQAISPRTL-NAWVKVVEEK and FRDYVDRFYKTLRAEQASQD were recognized in H-2^b and H-2^d mice

p24(11–30)	Gag(143–152 SF2)	VHQAISPRTLNAWVK-VVEEK	Vaccine	murine(H-2d and H-2b)	[Mata1999]
Vaccine: <i>Vector/type:</i> Listeria monocytogenes <i>Strain:</i> SF2 <i>HIV component:</i> p24 <ul style="list-style-type: none"> • Listeria monocytogenes is an intracellular bacterium that lives in the cytoplasm and generates a cell-mediated immune response • Listeria monocytogenes vaccine expressing HIV-1 p24 protein (Lm-Gag) was used to stimulate gag specific CD4+ T-cell proliferative responses in BALB/c(H-2d) and C57BL/6(H-2b) mice • Two of three reactive p24 peptides (out of 22 overlapping peptides that span p24) were recognized by both murine strains – this epitope is immunodominant in C57BL/6 mice and also can stimulate a BALB/c response • The proliferative response is due to CD4+, IFN-γ producing cells, a Th1 response 					
p24(21–36)	p24(153–167)	NAWVKVVEEKAFSPEK	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none"> • Epitope elicits a primary proliferative response in PBMC from uninfected donors 					
p24(31–46)	p24(163–177)	AFSPEVIPMFSALESEC	<i>in vitro</i> stimulation	human(A*0201)	[Bedford1997a]
<ul style="list-style-type: none"> • Elicits a primary proliferative response in PBMC from uninfected donors • Peptide contains a CTL epitope identified in HIV-positive patients • Peptide binds to HLA A*0201 and causes regulation of class I expression on T2 cells • Matches 3/3 anchor residues for HLA DR: VIPMFSALE 					
p24(31–52)	p24(163–184 SF2)	AFSPEVIPMFSALESEG-ATPQDL	HIV-1 infection	human()	[Rosenberg1997]
<ul style="list-style-type: none"> • Low viral load correlated with strong HIV-1-specific proliferative response • A proliferative response to this epitope was detected in two long term survivors 					
p24(41–56)	p24(173–187)	SALSEGATPQDLNTMC	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none"> • Epitope elicits a primary proliferative response in PBMC from uninfected donors 					
p24(48–62)	p24(180–194)	TPQDLNTMLNTVGGH	HIV-1 infection	human()	[Adams1997]
<ul style="list-style-type: none"> • One of four immunogenic Gag peptides used in study of proliferative response to p24 • Homology to an SIV epitope recognized by macaque T-cells • T-cells from 8/19 HIV+ individuals responded to this epitope • Improved assay system (increase in culture time to 8 days and addition of IL-2 to cultures) increased detection of proliferative response 					
p24(51–66)	p24(183–197)	DLNTMLNTYGGHQAA-C	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none"> • Epitope elicits a primary proliferative response in PBMC from uninfected donors 					

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p24(51–82)	Gag(183–214 LAI)	DLNTMLNTVGGHQAA- MQMLKETINEEAAEWD- R	Vaccine	human()	[Gahery-Segard2000a]
<p>Vaccine: <i>Vector/type:</i> lipopeptide</p> <ul style="list-style-type: none"> • Anti-HIV lipopeptide vaccine consisting of six long peptides derived from Nef, Gag and Env HIV-1 proteins modified by a palmitoyl chain was administered in a phase I trial • A CD4+ T-cell proliferative response to at least one of the six peptides was observed in 9/10 vaccinees – 2/10 reacted to this peptide • 9/12 tested mounted a CTL responses to at least one of the six peptides, each of the six peptides elicited a CTL response in at least one individual • None of the 12 tested had an IgG response to this peptide 					
p24(71–86)	p24(203–217)	ETINEEAAEWDRVHPC	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none"> • Epitope elicits a primary proliferative response in PBMC from uninfected donors 					
p24(76–85)	p24(208–217)	EAAEWDRVHP	HIV-1 infection	human()	[Adams1997]
<ul style="list-style-type: none"> • One of four immunogenic Gag peptides used in study of the proliferative response to p24 • T-cells from 11 of 24 HIV+ individuals responded to this epitope • Improved assay system (increase in culture time to 8 days and addition of IL-2 to cultures) increased detection of proliferative response 					
p24(76–90)	p24(208–222 IIIB B10)	EAAEWDRVHPVHAGP	HIV-1 infection	human()	[Wahren1989, Wahren1989a]
<ul style="list-style-type: none"> • 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses 					
p24(81–95)	p24(215–229 SF2)	DRVHPVHAGPIAPGQ	Vaccine	macaque()	[Mills1990]
<p>Vaccine: <i>Vector/type:</i> virus-like particle <i>Strain:</i> SF2 <i>HIV component:</i> p24</p> <ul style="list-style-type: none"> • Responses to 3 T-cell and multiple linear B-cell epitopes were found in vaccinated macaques 					
p24(81–102)	p24(213–234 SF2)	DRVHPVHAGPIAPGQ- MREPRGS	HIV-1 infection	human()	[Rosenberg1997]
<ul style="list-style-type: none"> • While anti-HIV CD4 Th responses are characteristically undetectable in chronic infections, strong p24-specific proliferative responses were inversely correlated with low viral load in 10 chronically infected people • The dominant proliferative response in one of two long term survivors was to this peptide 					
p24(87–101)	p24(219–233 BRU)	HAGPIAPGQMREPRG	<i>in vitro</i> stimulation	murine(H-2 ^b)	[Vaslin1994]
<ul style="list-style-type: none"> • Epitope name: Peptide G2. could prime for <i>in vitro</i> immunoproliferative responses and for subsequent IgG responses 					
p24(96–103)	p24(228–235 LAI)	MREPRGSD	HIV-1 infection	human()	[Schrier1989]
<ul style="list-style-type: none"> • Stimulates T-cell proliferation in HIV-infected donors 					
p24(96–110)	p24(228–242 IIIB B10)	MREPRGSKIAGTTST	HIV-1 infection	human()	[Wahren1989, Wahren1989a]

HIV Helper-T Cell Epitopes

- 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses

p24(101–115)	p24(235–249 SF2)	GSDIAGTTSTLQEIQI	Vaccine	macaque()	[Mills1990]
Vaccine: <i>Vector/type:</i> virus-like particle <i>Strain:</i> SF2 <i>HIV component:</i> p24					
<ul style="list-style-type: none"> • Responses to 3 T-cell and multiple linear B-cell epitopes were found in vaccinated macaques – epitope response defined by T-cell clone 					
p24(101–116)	p24()	GSDIAGTTSTLQEIQIC	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none"> • Epitope elicits a primary proliferative response in PBMC from uninfected donors 					
p24(111–132)	p24(243–264 SF2)	LQEQIGWMTNNPIIPV-GEIYKR	HIV-1 infection	human()	[Rosenberg1997]
<ul style="list-style-type: none"> • Low viral load correlated with strong HIV-1-specific proliferative response • A proliferative response to this epitope was detected in two long term survivors 					
p24(119–133)	p24(251–265)	TNNPIIPBGEIYKRW	HIV-1 infection	human(DRB1*1301)	[Blankson2001, Malhotra2001]
<ul style="list-style-type: none"> • The DRB1*13-DQB1*06 haplotype is associated with maintained viral suppression after HAART – 7/7 early-treated DRB1*13-DQB1*06 positive people, but only 3/14 (21%) of those who did not have DRB1*13-DQB1*06, maintained viral suppression for 18 months • PBMC from individuals with the haplotype DRB1*13-DQB1*06 displayed increased IFNγ secretion and stronger proliferative responses against p24 80 weeks post-treatment • DRB1*13-DQB1*06 was also found to be enriched among long-term non-progressors (LTNPs) (it was in 9/18 50%, versus 21% of the general population) • This epitope was mapped with truncated peptides using the Elispot assay • Two distinct DRB1*13 epitopes were defined in the peptide region spanning 251 to 270, and this 20-mer bound with very high affinity to DRB1*1302 – DRB1*1301 and DRB1*1302 would be expected to have very similar binding properties 					
p24(121–136)	p24(253–267)	NNPIPVGEIYKRWIIC	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none"> • Epitope elicits a primary proliferative response in PBMC from uninfected donors 					
p24(121–140)	p24(253–272 HXB2)	NNPIPVGEIYKRWIILG-LNK	Vaccine	murine(H-2 ^d)	[Mata1999]
Vaccine: <i>Vector/type:</i> <i>Listeria monocytogenes</i> <i>Strain:</i> HXB2 <i>HIV component:</i> Gag					
<ul style="list-style-type: none"> • BALB/c and C57BL/6 mice were immunized with rec <i>Listeria monocytogenes</i> (Lm-Gag) expressing HIV-1 HXB2 Gag • <i>L. monocytogenes</i> is a gram-positive bacteria that enters the macrophage on phagocytosis and lives in the cytoplasm – secreted <i>L. monocytogenes</i> antigens are processed and presented by both class I and class II pathways • The class II T-helper response was probed using 20 mer peptides that overlapped by 10, and the peptide MPPIPVGEIYKRWIILGLNK gave the immunodominant response for the H-2^d haplotype, but was not recognized in H-2^b mice 					

p24(121–140)	Gag(253–272 SF2)	NPPIPVG E I Y K R W I L G L - NK	Vaccine	murine(H-2d)	[Mata1999]
<p>Vaccine: <i>Vector/type:</i> Listeria monocytogenes <i>Strain:</i> SF2 <i>HIV component:</i> p24</p> <ul style="list-style-type: none"> • Listeria monocytogenes is an intracellular bacterium that lives in the cytoplasm and generates a cell-mediated immune response • Listeria monocytogenes vaccine expressing HIV-1 p24 protein (Lm-Gag) was used to stimulate gag specific CD4+ T-cell proliferative responses in BALB/c(H-2d) and C57BL/6(H-2b) mice • Two of three reactive p24 peptides (out of 22 overlapping peptides that span p24) were recognized by both murine strains – this epitope is immunodominant in BALB/c mice and did not stimulate a C57BL/6 response • The proliferative response is due to CD4+, IFN-γ producing cells, a Th1 response 					
p24(121–152)	Gag(183–214 LAI)	NPPIPVG E I Y K R W I I L G - LNKIVRMYSPTSILD	Vaccine	human()	[Gahery-Segard2000a]
<p>Vaccine: <i>Vector/type:</i> lipopeptide</p> <ul style="list-style-type: none"> • Anti-HIV lipopeptide vaccine consisting of six long peptides derived from Nef, Gag and Env HIV-1 proteins modified by a palmitoyl chain was administered in a phase I trial • A CD4+ T-cell proliferative response to at least one of the six peptides was observed in 9/10 vaccinees – 9/10 reacted to this peptide • 9/12 tested mounted a CTL responses to at least one of the six peptides, each of the six peptides elicited a CTL response in at least one individual – this peptide was particularly immunogenic, eliciting a CTL response in four vaccinees • All of the 12 tested had an IgG response to this peptide 					
p24(127–140)	Gag(294–308)	GEIYKRWIILGLNKI	HIV-1 infection	human(DR supermotif)	[Wilson2001]
<ul style="list-style-type: none"> • Epitope name: Gag 294. Eleven peptides were identified that had the HLA-DR supermotif, all were found to bind to MHC class II DR molecules and all elicited proliferative responses from multiple HIV-infected donors • This epitope binds ten HLA-DR alleles: DRB1*0101, DRB1*1501, DRB1*0405, DRB1*1101, DRB1*1302, DRB1*0701, DRB1*0802, DRB1*0901, DRB5*0101 and DRB4*0101 with an IC50 threshold below 1,000 nM • This epitope sequence is conserved in 95% of clade B isolates • 6/22 HIV infected individuals responded to this epitope (13/22 responded to some of the DR supermotif epitopes, the 9 non-responder peptides tended to also not have recall responses to rec HIV-1 whole proteins) 					
p24(128–137)	p24(260–269)	EIYKRWIILG	HIV-1 infection	human(DRB1*1301, DRB1*1302)	[Blankson2001, Malho- tra2001]
<ul style="list-style-type: none"> • The DRB1*13-DQB1*06 haplotype is associated with maintained viral suppression after HAART – 7/7 early-treated DRB1*13-DQB1*06 positive people, but only 3/14 (21%) of those who did not have DRB1*13-DQB1*06, maintained viral suppression for 18 months • PBMC from individuals with the haplotype DRB1*13-DQB1*06 displayed increased IFNγ secretion and stronger proliferative responses against p24 80 weeks post-treatment • DRB1*13-DQB1*06 was also found to be enriched among long-term non-progressors (it was in 9/18 versus, versus 21% of the general population) 					

HIV Helper-T Cell Epitopes

- The truncated peptide that gave the optimal proliferative response for a Th1 phenotype clone was this nine-mer
- This region, shared by 2 overlapping peptides, was the reactive region for clones from two DRB1*13 patients, one carried DRB1*1301 and one DRB1*1302
- Two distinct epitopes were defined in the peptide region spanning 251 to 270, and this 20-mer bound with very high affinity to DRB1*1302 – DRB1*1301 and DRB1*1302 would be expected to have very similar binding properties

p24(131–145)	p24(265–279 SF2)	KRWIILGLNKIVRMY	Vaccine	macaque()	[Mills1990]
Vaccine: <i>Vector/type:</i> virus-like particle <i>Strain:</i> SF2 <i>HIV component:</i> p24					
<ul style="list-style-type: none"> • Responses to 3 T-cell and multiple linear B-cell epitopes were found in vaccinated macaques – epitope response defined by T-cell clone 					
p24(131–145)	Gag(298–312)	KRWIILGLNKIVRMY	HIV-1 infection	human(DR supermotif)	[Wilson2001]
<ul style="list-style-type: none"> • Epitope name: Gag 298. Eleven peptides were identified that had the HLA-DR supermotif, all were found to bind to MHC class II DR molecules and all elicited proliferative responses from multiple HIV-infected donors • This epitope binds thirteen HLA-DR alleles: DRB4*0101, DRB5*0101, DRB1*0901, DRB1*0802, DRB1*0701, DRB1*1302, DRB1*1201, DRB1*1101, DRB1*0405, DRB1*0401, DRB1*0301, DRB1*1501 and DRB1*0101, with an IC50 threshold below 1,000 nM • This epitope sequence is conserved in 94% of clade B isolates • 8/22 HIV infected individuals responded to this epitope (13/22 responded to some of the DR supermotif epitopes, the 9 non-responder peptides tended to also not have recall responses to rec HIV-1 whole proteins) 					
p24(131–152)	p24(263–284 SF2)	KRWIILGLNKIVRMYS-PTSILD	HIV-1 infection	human()	[Rosenberg1997]
<ul style="list-style-type: none"> • Low viral load correlated with strong HIV-1-specific proliferative response • A proliferative response to this epitope was detected in two long term survivors 					
p24(135–154)	p24(267–286)	ILGLNKIVRMYSPTSIL-DIR	HIV-1 infection	human()	[Adams1997]
<ul style="list-style-type: none"> • One of four immunogenic Gag peptides used in study of the proliferative response to p24 • 8/24 HIV+ individuals responded to this epitope • Improved assay system (increase in culture time to 8 days and addition of IL-2 to cultures) increased detection of proliferative response 					
p24(141–156)	p24(273–287)	IVRMYSPTSILDIRQC	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none"> • Epitope elicits a primary proliferative response in PBMC from uninfected donors • Matches 3/3 anchor residues for HLA DR: IVRMYSPTS 					
p24(146–160)	p24(278–292 IIIB B10)	SPTSILDIRQGPKEP	HIV-1 infection	human()	[Wahren1989, Wahren1989a]
<ul style="list-style-type: none"> • 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses 					

HIV Helper-T Cell Epitopes

p24(150–169)	p24(282–301)	ILDIRQGPKEPFRDYV-DRFY	HIV-1 infection	human()	[Schrier1989]
<ul style="list-style-type: none"> Stimulates T-cell proliferation in HIV-infected donors 					
p24(151–166)	p24(283–297)	LDIRQGPKEPFRDYVC	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none"> Epitope elicits a primary proliferative response in PBMC from uninfected donors 					
p24(155–177)	p24(287–309)	QGPKEPFRDYVDRFY-KTLRAEQA	Vaccine	murine()	[Nakamura1997a]
<p>Vaccine: Vector/type: peptide</p> <ul style="list-style-type: none"> Mice immunized with this peptide generated proliferative responses, CTLs and antibodies This immunogenic domain is from a highly conserved region of p24 					
p24(156–170)	p24(288–302 IIIB B10)	GPKEPFRDYVDRFYK	HIV-1 infection	human()	[Wahren1989, Wahren1989a]
<ul style="list-style-type: none"> 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses 					
p24(156–174)	p24(287–306)	QPKEPFRDYVDRFYK-TLRA	HIV-1 infection	human()	[Adams1997]
<ul style="list-style-type: none"> One of four immunogenic Gag peptides used in study of the proliferative response to p24 T-cells from 5/21 HIV+ individuals responded to this epitope Improved assay system (increase in culture time to 8 days and addition of IL-2 to cultures) increased detection of proliferative response 					
p24(161–180)	p24(293–312 HXB2)	FRDYVDRFYKTLRAE-QASQD	Vaccine	murine(H-2 ^d , H-2 ^b)	[Mata1999]
<p>Vaccine: Vector/type: <i>Listeria monocytogenes</i> Strain: HXB2 HIV component: Gag</p> <ul style="list-style-type: none"> BALB/c and C57BL/6 mice were immunized with rec <i>Listeria monocytogenes</i> (Lm-Gag) expressing HIV-1 HXB2 Gag <i>L. monocytogenes</i> is a gram-positive bacteria that enters the macrophage on phagocytosis and lives in the cytoplasm – secreted <i>L. monocytogenes</i> antigens are processed and presented by both class I and class II pathways The class II T-helper response was probed using 20 mer peptides that overlapped by 10, and the peptides VHQAISPRTL-NAWVKVVEEK and FRDYVDRFYKTLRAEQASQD were recognized in H-2^b and H-2^d mice 					
p24(161–180)	Gag(293–312 SF2)	FRDYVDRFYKTLRAE-QASQD	Vaccine	murine(H-2d and H-2b)	[Mata1999]
<p>Vaccine: Vector/type: <i>Listeria monocytogenes</i> Strain: SF2 HIV component: p24</p> <ul style="list-style-type: none"> <i>Listeria monocytogenes</i> is an intracellular bacterium that lives in the cytoplasm and generates a cell-mediated immune response <i>Listeria monocytogenes</i> vaccine expressing HIV-1 p24 protein (Lm-Gag) was used to stimulate gag specific CD4+ T-cell proliferative responses in BALB/c(H-2d) and C57BL/6(H-2b) mice 					

HIV Helper-T Cell Epitopes

- Two of three reactive p24 peptides (out of 22 overlapping peptides that span p24) were recognized by both murine strains – this peptide stimulated a response in both BALB/c and C57BL/6 mice
- The proliferative response is due to CD4+, IFN- γ producing cells, a Th1 response

p24(163–177)	p24(295–309)	DYVDRFYKTLRAEQA	HIV-1 infection	human(DRB1*1302)	[Blankson2001, Malho-tra2001]
<ul style="list-style-type: none">• The DRB1*13-DQB1*06 haplotype is associated with maintained viral suppression after HAART – 7/7 early-treated DRB1*13-DQB1*06 positive people, but only 3/14 (21%) of those who did not have DRB1*13-DQB1*06, maintained viral suppression for 18 months• PBMC from individuals with the haplotype DRB1*13-DQB1*06 displayed increased IFNγ secretion and stronger proliferative responses against p24 80 weeks post-treatment• DRB1*13-DQB1*06 was also found to be enriched among long-term non-progressors (it was in 9/18 versus, versus 21% of the general population)• This epitope was mapped with truncated peptides using the Elispot assay, and is highly conserved					
p24(181–196)	p24(313–327)	VKNWMTETLLVQNAN- C	<i>in vitro</i> stimulation	human()	[Bedford1997a]
<ul style="list-style-type: none">• Epitope elicits a primary proliferative response in PBMC from uninfected donors• Matches 3/3 anchor residues for HLA DR: VKNWMTETL					